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The physical conditioning (PC) program in Air Force Basic Military Training (BMT) was changed in 1995 from a "one size fits all" approach of running in formation and group calisthenics to an individually tailored physical regimen designed to encourage long-term participation in exercise and reduced risk of cardiovascular disease. Prior to the implementation of the new PC program, a study was conducted to compare fitness levels, injury rates, and motivation to exercise among 2,547 male recruits and 701 female recruits randomly assigned to the old and new PC programs. The study showed that female recruits in the new PC program posted greater reductions in their 2-mile run times than those in the old PC program. Differences between the two PC program were most pronounced among those who were able to meet Air Force run-time standards at the start of BMT. Despite more rigorous training in the new PC program, the injury rates between the two PC programs were not significantly different. The new PC program did not significantly affect attrition rates among female participants. Instead, the study found that female recruits who began BMT with a positive attitude toward exercise and who exercised regularly prior to the start of BMT graduated at significantly higher rates than those who were unmotivated and unprepared.

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Vincent G Iannacchione 7.30.98

PI - Signature Date

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INTRODUCTION

Background. During the 1993 biennial review of basic military training (BMT) senior enlisted advisors from various Air Force Major Commands concluded that the BMT physical fitness program did not meet the goals of health, fitness, and readiness. Overall, more than 30,000 young men and women participate in BMT each year, and it was recognized that the physical conditioning component of BMT offered an excellent opportunity for encouraging long-term participation in exercise in order to facilitate maintaining a physically fit work force that meets standards of military readiness. Thus, the "one size fits all" approach of running in formation and group calisthenics has been replaced by an individually tailored physical regimen supplemented with classes on exercise physiology, nutrition and diet, and physical fitness. Training instructors, once cast as strict disciplinarians who did not participate in the exercises, now act a role models who join in the exercises and provide positive reinforcement.

Basic military training is a stressful time for military recruits both physically and psychologically. There are changes in almost every aspect of the recruit's life. There are sharp increases in physical activity resulting from training activities, marches, physical conditioning, maintenance of barracks and so on. In addition, they must adjust to military discipline, are housed in close quarters with strangers, and may be away from home for the first time. In short, their whole life style changes dramatically.

This intense period of training has both positive and negative outcomes. On the positive side, most recruits learn to meet military standards of behavior, discipline, neatness and achieve the required physical fitness standards in a very short time. However, these positive outcomes are combined with negative outcomes of attrition (failure to complete the training) and injury. Examining forces worldwide, estimates of the number of recruits sustaining injuries rise as high as 85 percent for overuse injuries with recruits in the Israeli infantry sustaining stress fractures at a rate of 23 to 31 percent (Jones and Woodward, 1994). The recruitment, transportation, and training of recruits who are not able to complete basic training is costly, and it has been estimated that, in the US Armed Forces, over $200 million per year would be saved if ways could be found to maximize the positive outcomes and minimize the negative.

Men and women recruits react differently to the physical demands of BMT. Women have higher rates of injury and higher attrition rates (Jones, et al., 1993; Reinker and Ozbourne, 1979; Ross and Woodward, 1994). These differing reactions arise from the intrinsic gender differences in muscular strength and cardiovascular capacity (Jette, Sidney, and Kimick, 1989; Ogawa, et al., 1992), from differences in pre-enlistment physical activity (Ross and Woodward, 1994), and, possibly, from differing expectations and attitudes toward exercise (Hawkes and Holm, 1993; Sallis, et al., 1992; Treiber, et al., 1991). In addition, these factors interact with the characteristics of the physical conditioning program to produce differing levels of physical stress.

The participation of women in the US Armed Forces had been increasing, and in 1995

there were nearly 200,000 women on active duty which accounted for nearly 14 percent of the active duty personnel (IOM, 1995). In the Air Force, where more than 20 percent of all recruits are young women, it is particularly important to understand the factors influencing fitness and performance of women and the relationship of these factors to military programs so as to find ways to enhance the performance of women and take full advantage of the investment in their recruitment and training.

Prior research has shown that there are a number of risk factors for injury during military training. Ross and Woodward (1994) conducted a case-control study of overuse injuries among male and female recruits who participated in a nine week basic military training program in the Royal Australian Air Force between 1985 and 1990. They found that women were at higher risk of injury and that, among both men and women, high body mass index, winter training, prior history of injury to the lower limbs and physical problems with the lower limbs were associated with greater risk of injury. Using a pre-enlistment activity rating based on a few questions about participation in sports prior to enlistment, they showed that physical activity levels prior to beginning basic training was also associated with lower injury rates.

Initiation of exercise programs prior to enlistment, response to the conditioning program during BMT, and continuation of exercise behaviors that promote continuing fitness are likely to be influenced by both social and personal factors. In a community study that examined the relationship between a number of factors on initiation and maintenance of vigorous physical activity, Sallis, Hovell, and Hofstetter (1992) noted differences between men and women in both the factors associated with the adoption of vigorous activity and its maintenance. Among both men and women who were sedentary at the beginning of the study, high exercise self-efficacy scores and a history of participation in physical activity were associated with adoption of vigorous physical activity during the 24 month follow-up period. Men and women differed, however, on other factors. For women, social support from family and friends was positively associated with adoption of physical activity; whereas, among men, environmental factors such as the availability of exercise facilities and a neighborhood setting conducive to exercise were positively associated with adoption of exercise. For physically active women the only significant factors associated with maintaining high levels of activity were education and age. In contrast, for men a number of factors were important including exercise self-efficacy scores, body mass index, perceptions of benefits associated with exercise, and convenience of exercise facilities.

Other studies have shown the importance of social factors on exercise behavior with Trieber, et al. (1991) finding that perceived support by family and friends being associated with high levels of activity for both men and women and Hawkes and Holm (1993) finding that social influences were predictive of exercise levels in men. This latter study found that attitudes toward physical exercise and fitness were more important for women and that women were less sensitive to social influences. The importance of environmental factors in promoting physical fitness was also demonstrated by Linenger, Chesson, and Nice (1991) who found that simple environmental changes such as more bicycle paths, exercise equipment and clubs, and so on were associated with improved run times and overall physical readiness test scores.

The New Physical Conditioning (PC) Program. The new PC program in U.S. Air Force BMT was designed to 1) teach the recruit that fitness is a way of life, 2) establish tougher fitness standards, and 3) focus on fitness gains during BMT. After a baseline assessment of fitness, recruits were grouped according to five levels of fitness ranging from unfit to elite. Three specific goals of the conditioning program were delineated for the recruit, namely, to meet all graduation standards, achieve increased well-rounded fitness, and learn physical activity skills that will promote long-term physical activity. To achieve these goals, recruits ran on the road or special tracks and used circuit resistance training using an individualized program which emphasized endurance. Their training instructors also participated in the conditioning program serving as role models and providing positive reinforcement.

The new PC program also included four hours of classroom instruction on basic exercise physiology, physical fitness standards, components and principles of exercise, and building a personalized physical activity schedule. The goals of the instruction were to provide the recruit with the knowledge required to 1) understand the body's response to different types of activities, 2) determine which activities will promote fitness, strength, and endurance, 3) develop an individualized activity schedule, and 4) recognize the importance of life-long, regular physical activity.

US Air Force Recruit Fitness Study (AFRFS). Prior to the adoption of the new physical conditioning program, the AFRFS (Iannacchione 1995) was conducted by the Office of Prevention and Health Services Assessment (OPHSA) and Battelle Memorial Institute to evaluate the effects of the new PC program on:

- Level of fitness at the end of BMT
- Attitudes and knowledge related to physical fitness
- Fitness-related injury rates
- Attrition rates

A total of 3,248 male and female recruits who attended BMT at Lackland AFB from 12 September through 23 November 1994 participated in the study. Approximately 22 percent of the recruits who participated in the study were women. For each recruit, three types of data were collected during the study: physical fitness evaluations, questionnaire data, and health care utilization data.

Purpose of the Research. We performed detailed multi-variate analysis of the AFRFS data to investigate the determinants of the physical conditioning of recruits both before they entered BMT and after being trained in the old and new PC programs. The following research questions were addressed by the analysis.

- Research questions about fitness activities 30 days prior to the start of BMT:
  What kind of fitness activities are done?
  How much time is spent on fitness activities?

Do pre-BMT fitness activities affect fitness-related injuries during BMT?
Do pre-BMT fitness activities affect attrition rates?

- Research questions about the new PC Program:
  Does the new PC improve physical fitness during BMT?
  Does the new PC improve attitudes toward fitness during BMT?
  Does the new PC cause more injuries during BMT?
  Does the new PC affect attrition rates?

All of the above questions were examined from the standpoint of determining whether there were substantive differences between male and female recruits.

BODY

Study Population. When recruits arrive at Lackland AFB, they are assigned to one of five training squadrons in order of their arrival at Lackland. Squadron members are housed in the same barracks and are divided into *flights* for training activities. The experiment was implemented by assigning the new PC program to two squadrons and the old PC program to two others. The fifth training squadron did not participate in the Study. Because recruits were assigned to squadrons and flights on the basis of arrival at Lackland, their assignment to treatments was assumed to be random and independent. **Exhibit 1** summarizes the participation of male and female recruits and the data available for analysis.

Exhibit 1. Summary of Study Population and Data Collected

Participation Status	Female Recruits		Male Recruits		All Recruits	
	Number	Percent	Number	Percent	Number	Percent
Total enrolled	701	100.0	2,547	100.0	3,248	100.0
Completed BMT	602	86.0	2,371	93.0	2,973	92.0
Remained in same flight	503	72.0	2,097	82.0	2,600	80.0
Recycled into a study flight	4	0.6	33	1.3	37	1.1
Recycled out of a study flight	95	14.0	241	10.0	336	10.0
Did not complete BMT						
Discharged	94	13.4	172	6.8	266	8.2
On medical hold	5	0.7	4	0.2	9	0.3
Data available:						
Baseline two mile run	661	94.3	2,218	87.1	2,879	88.6
Post two-mile run	537	76.6	2,235	87.7	2,272	70.0
Baseline and post two-mile run	516	73.6	1,985	77.9	2,501	77.0
Baseline questionnaire	669	95.4	2,446	96.0	3,115	95.9
Post questionnaire	577	82.3	2,294	90.1	2,871	88.4
Baseline and post questionnaire	566	80.7	2,248	88.3	2,814	86.6
Medical data:						
Any encounter	449	64.0	1,004	39.4	1,453	44.7
Likely exercise related injury	263	37.5	400	15.7	663	20.4

Analytic Methods. Because recruits were assigned to flights within squadrons on the basis of their arrival date at Lackland, their assignment to treatments was assumed to be random and hence, independent. However, most recruits experienced their training as members of the same flight, sharing the peer pressures of their fellow recruits and sharing the significant influence of the flight's Training Instructor (TI). If these shared experiences among flight members result in shared attitudes toward fitness, then the assumption of independence among the sample members may underestimate the true variability in the fitness measures. Therefore, a nested design was used to evaluate the effects of the new PC program.

Similarities among flight members may indeed influence the variability of the major outcome measures. For example, a flight's group dynamics may exert a positive or negative influence on its members' attitude toward fitness. Or, a TI with a stoic training philosophy may make recruits in his/her flight less likely to report an injury. Even PC run times may be affected if a flight takes on a team-oriented approach where the faster runners lag behind to encourage slower runners. To properly account for these potential intra-cluster correlations, much of the proposed analysis of the outcome measures assumes a nested factorial design. A nested design (as opposed to say, a randomized block design) is needed because the treatment combinations affect whole flights rather than individuals within flights (as in an inter-penetrating design). As a result, the ability to detect flight-induced effects was influenced by the number of flights in the sample.

A nested analytic design enabled the use of variance components to quantify the amount of total variation in an outcome that is attributable to variation among the flights versus the amount attributable to individual recruits within flights. To develop this design, a mixed model containing both fixed and random effects was specified. The two treatments (i.e., old and new PC) were considered fixed because of interest in differences between the specified treatment levels. In contrast, the effects attributable to the group dynamics of flights were considered random because the flights in the sample were drawn from a larger population of flights. This seems plausible, especially if we acknowledge that the potential for differences among flights is myriad and only partially captured by the flights in our sample.

The use of a design that involves repeated (i.e., before and after) measures obviates the need for an analytic model that contains a large number of covariates representing recruit characteristics. However, the initial tabulations indicated that the new PC program had a differential impact on two covariates: gender and physical condition at entry. In our nested design, these two covariates will be specified differently because gender does not vary within flights while physical condition at entry does. This leads to gender-specific models with the following fully specified model for some outcome variable Y:

$$Y_{ijkm} = \alpha + P_i + F_{j(i)} + C_k + C_kP_i + C_kF_{j(i)} + \epsilon_{m(ijk)}$$

where

α = Fixed effect of the general mean,

P_i = Fixed effect of PC program, i = 1 (new) and 2 (old),

$F_{j(i)}$ = Random effect of flight *j* within treatment combination *i*
C_k = Fixed effect of physical condition at entry, $k = 1$ (fit) and 2 (unfit)
$\epsilon_{m(ijk)}$ = Random effect of residual *m* within each *ijk* combination

Notice that the treatment combinations, unlike physical condition at entry, are not interacted with flights. This is because physical condition varies within flights, but the treatment combinations do not. Hence, the interactive effects between flights and treatments are confounded. Instead, flights are nested within treatment combinations and then pooled to estimate the variance component attributable to flights.

The nested factorial design specified above was not applied to balanced data because the number of observations in the sub-most subclasses (i.e., the *ijk* combinations) were not the same. As a result, use of the analysis-of-variance method for mixed models may lead to biased estimates of the fixed effects and the variance components of the random effects (Searle 1971). To avoid this, the SUDAAN software for correlated data (Shah 1995) was used for to evaluate the effectiveness of the new PC program. The procedures available in SUDAAN allow for unbalanced data for mixed effects models to account for the clustering attributable to flights.

Data Used for Analysis. Three types of data were collected during the study: *physical fitness evaluations, questionnaire data, and health care utilization data.* In addition, separation reports and discharge data were collected for those recruits who were discharged for medical reasons. The physical fitness evaluations were done on the second day of BMT (baseline measurements) and during the last week of training (post training measures) and consisted of two-mile run times and an assessment of maximum number of pull-ups and push-ups. However, because some errors were made in the collection of data on push-ups and pull-ups for some female recruits, only the baseline and final two-mile run times were analyzed in this study.

Questionnaire data were also collected at both the start and end of BMT. Questionnaire items addressing: knowledge, attitudes towards exercise, self-confidence, self-efficacy, and team work were asked both at baseline and post-training. In addition, the recruits were queried at baseline concerning their pre-BMT exercise behaviors; and, the post-training questionnaire included items self-assessment items addressing improvement in physical fitness and unreported injuries during the course of BMT. A detailed list of the data available for the analysis is presented in **Appendix A**.

Results. The General Accounting Office (1997) reports that many recruits have problems meeting BMT performance standards because 1) they are not prepared, and 2) because they lack motivation. Our analysis shows that female recruits in Air Force BMT experienced both of these problems to a greater extent than their male counterparts. As **Exhibit 2** shows, 61% of female recruits were unable to pass the baseline two-mile run test that is given on day two of BMT[1]. In

[1] The run-time standards set by the Air Force for the two-mile run are 21:30 for females and 18:00 for males.

contrast, only 39% of male recruits were unable to pass the baseline run. Female recruits were also more likely to be above the desired weight (as prescribed by AFI 40-502, 1994) and to experience a fitness-related injury during the first week of training.

Exhibit 2. Baseline Fitness Levels of AFRFS Study Participants

Baseline Status	Females n = 613	Males n = 1,864	Difference (F - M)	Level of Significance
Unable to pass 2-mile run test	61%	39%	21%	< 0.0001
Above desired weight	31%	19%	12%	< 0.0001
Exercise-related injury during first week	10%	5%	5%	< 0.0001

*1. **Pre-Enlistment Fitness Activities**.* As part of the baseline questionnaire, recruits were asked to report on their fitness-related activities during the 30 days prior to their arrival at BMT. The amount of time spent exercising was requested for 35 different fitness activities. Because many of the individual activities were either reported infrequently (e.g., canoeing or backpacking) or were very similar (e.g., swim sprints or swim laps), we grouped the 35 individual fitness activities into six major activity groupings using a classification scheme proposed by Ainsworth *et al* (1993). Classifying activities into major groupings was desirable for two reasons: 1) the major groupings allowed us to work with larger sample sizes and thus obtain more stable sample estimates; and 2) the major activity groupings allowed us to either impute or discard inconsistent and out-of-range answers reported by recruits. The mapping of individual activities into major activity groupings is described in **Appendix B** and the edit and imputation procedures for reported time spent on the activities are described in **Appendix C**.

Nearly all recruits (94% of females and 96% of males reported doing one or more hours per week of exercise during the 30 days prior to their arrival at Lackland AFB. In fact, the vast majority (87% of females and 91% of males) reported doing three or more hours per week of exercise during the 30 days prior. As can seen in **Exhibit 3**, male and female recruits reported doing similar types of exercise although there were two notable exceptions. Females were significantly more likely to spend time walking than their male counterparts (34% of females reported spending three or more hours per week walking versus 21% of males), while males were significantly more likely to spend time playing sports than females (60% of males reported spending three or more hours per week playing sports versus 33% for females).

We examined the effect of pre-BMT fitness activities on the recruit's performance for the baseline two-mile run test given on the second day of BMT. Not surprisingly, male and female recruits who spent three or more hours per week running prior to the start of BMT were the most likely to meet the run-time performance standards. The baseline passing rate for female recruits increased from 31% among those who ran less than 15 minutes per week (non-runners) to more

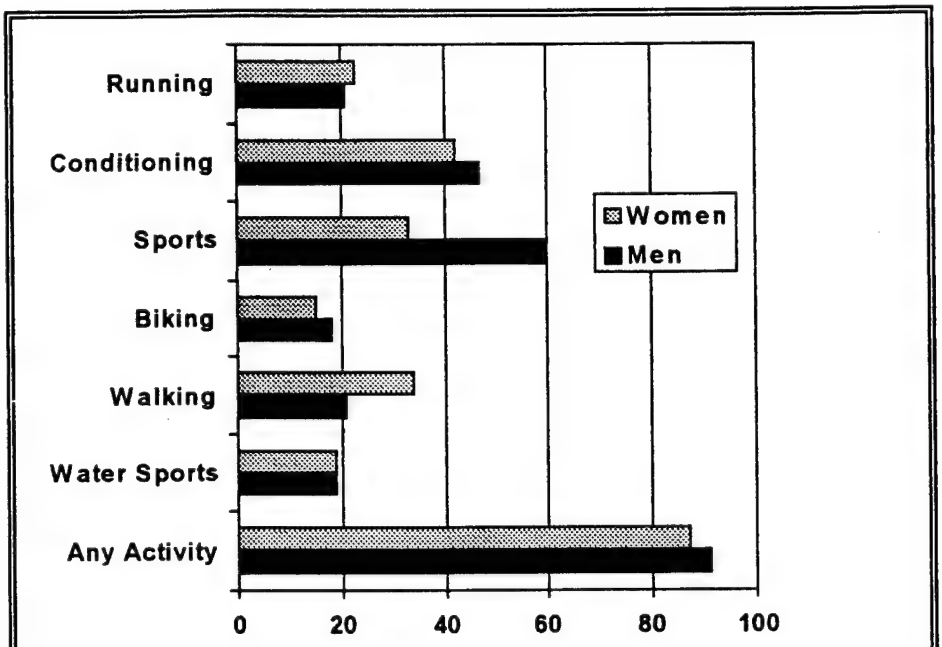

Exhibit 3. Percentage of Recruits spending three or more hours/week exercising during the 30 days prior to BMT.

than 57% among those who ran three or more hours per week (devoted runners). However, as the segmentation analysis in **Exhibit 4** shows, non-runners who spent 15 or minutes per week on conditioning had a 37% passing rate, nearly equal to the overall rate of 39%. The positive effect of cross-training is evident among devoted runners who also spent time bicycling. For the segmentation analysis, we required that the chi-square test statistics be significant at the 0.01 level and that each segment have at least 50 persons.

We found a similar trend of increasing passing rates for the baseline two-mile run among male recruits who ran regularly during the 30 days prior to the start of BMT. As **Exhibit 5** shows, males who ran between 15 minutes and three hours per week had a higher mean passing rate if they also played sports regularly. Males who ran more than three hours per week but did not do regular conditioning exercises actually had a lower-than-average passing rate.

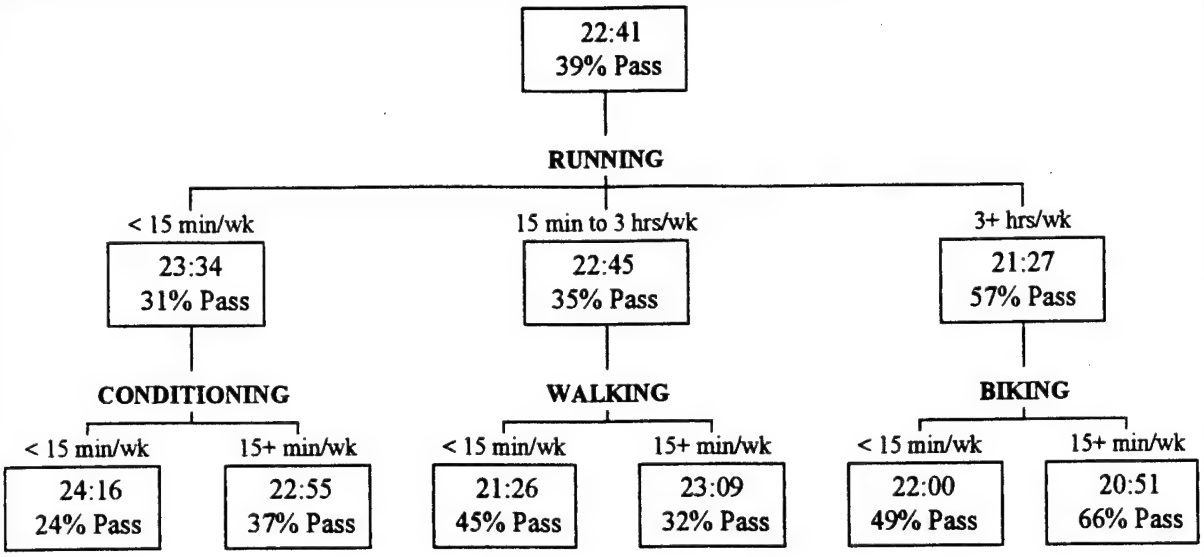

Exhibit 4. Preparing for the Baseline Two-Mile Run - Females. 39% of female recruits were able to pass the baseline run test with an average time of 22:41. The passing rate increased significantly for those who ran regularly during the 30 days prior to BMT. However, the combination of conditioning exercises, walking, and biking with different levels of running also affected the passing rates.

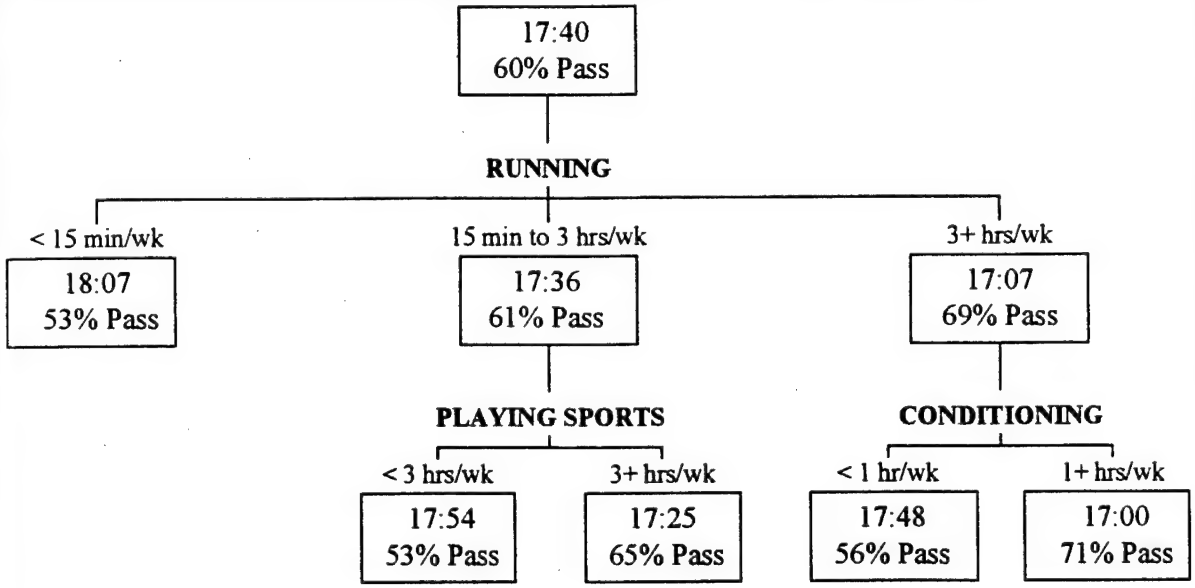

Exhibit 5. Preparing for the Baseline Run - Males. 60% of male recruits were able to pass the baseline run test with an average time of 17:40. The passing rate increased significantly for those who ran regularly during the 30 days prior to BMT. However, the combination of moderate running and playing sports, or heavy running and conditioning significantly improved the passing rates.

*2. **Baseline Motivation to Exercise.*** We constructed an attitudinal scale from 14 questionnaire items to summarize each recruit's overall attitude toward physical fitness. The questionnaire items were statements about various aspects of physical fitness that asked the recruit to respond on a five-point scale that ranged from "strongly disagree" to "strongly agree." The scale was computed as the sum of the fourteen answers after reversing the direction of items with a negative implication (e.g., "I only exercise because I am required to."). We used *Cronbach's Coefficient Alpha* (CCA) (Cronbach 1951) to assess the internal consistency of the items. The results of the correlation analysis indicated an overall CCA of 0.83 among female recruits and 0.85 among male recruits. The CCAs between each questionnaire item and the scaled total of the remaining items are shown in **Appendix D**.

Using the composite attitudinal scale as a measure, female recruits reported being less motivated to exercise at baseline than their male counterparts. As **Exhibit 6** shows, the attitudinal differences between genders were significant even when males and females were grouped by their ability to pass the baseline two-mile run test. As might be expected, motivation to exercise was strongly influenced by level of fitness. For example, among females who passes the baseline run test, 55% agreed or strongly agreed with the statement that they "exercise to feel healthy" compared to only 33% among females who failed the baseline test. Similar differences were found between fit (i.e., able to pass the baseline run) and unfit males although at somewhat higher levels. In fact, 84% agreement on the composite attitudinal scale among fit females is only slightly higher than the 81% reported by unfit males.

Exhibit 6. Baseline Attitudes about Exercise

	Pass Baseline Run			Fail Baseline Run		
	Females n = 239	Males n = 1,137	Difference[2] (F - M)	Females n = 374	Males n = 727	Difference[2] (F - M)
Agree or strongly agree with:						
Exercise to feel healthy	55%	57%	ns	33%	44%	-11%
Exercise to improve endurance	76%	80%	ns	64%	67%	ns
Exercise to improve strength	78%	89%	-11%	69%	84%	ns
Exercise because it's required	13%	10%	ns	25%	18%	+7%
Physical activities not for me	8%	5%	ns	15%	13%	ns
Composite motivation scale[1]	84%	95%	-11%	72%	81%	-9%

[1] Based on responses to 14 questions about attitudes toward exercise (including the five listed here). Responses to statements with negative connotation (e.g., exercise because it's required) are reversed for consistency.
[2] Differences reported are significant at the 0.05 level.

3. The Effects of the New PC Program on Two-Mile Run Times. The two-mile run times of most recruits improved noticeably during the five weeks between the baseline and final two-mile runs. As **Exhibit** 7 shows, the mean two-mile run times were lower regardless of gender, type of PC program, or fitness level at entry. However, males and females who were in the new PC program showed significantly more improvement than those in the old PC program, with the most significant differences occurring among those who were already fit at the start of BMT.

Among males, about 42 percent of those in the old PC program and 33 percent of those in the new program failed to meet the two-mile run-time standard of 18:00 or less. By the end of BMT, virtually all males in the new program met the standard compared to an 82 percent pass rate among those in the old program. In addition, almost 13 percent of the recruits in the old program who initially met the run-time standard failed to make the standard at the end of BMT.

Exhibit 7. Mean Reductions in Two-Mile Run Times by Gender and Baseline Run Time Standards[1]

Males

	Failed Baseline		Passed Baseline		Overall	
	New PC	Old PC	New PC	Old PC	New PC	Old PC
Mean Reduction	3:50	2:58	1:26	:24	2:13	1:27
Standard Error	:06	:07	:03	.05	:04	:05
Sample Size	311	381	637	518	948	899
New PC - Old PC	:52		1:01		:44	
Level of Significance[3]	0.014		0.0002		*	

Females

	Failed Baseline		Passed Baseline		Overall	
	New PC	Old PC	New PC	Old PC	New PC	Old PC
Mean Reduction	4:49	4:15	2:06	:21	3:33	2:43
Standard Error	:11	:10	:08	:10	:09	:11
Sample Size	137	124	121	81	258	205
New PC - Old PC	:34		1:45		:49	
Level of Significance[3]	0.100		0.0003		*	

1 Two-Mile Run Time Standards: Males: At or below 18:00; Females: At or below 21:30

2 Standard errors include intracluster correlations attributable to differences between flights.

3 One-tailed *t-test* with degrees of freedom equal to the number of flights minus the number of squadrons.

* Overall tests of significance are not reported because of confounding between pass/fail baseline status.

Among females, about 60 percent of those in the old program and 53 percent of those in the new program failed to meet the 21:30 run-time standard at baseline. By the end of BMT, all females in the new program and 93 percent of those in the old program were able to pass the run-time standard.

4. The Effects of the New PC Program on Attitudes Towards Fitness. A clear majority of male and female recruits who completed BMT reported a more positive attitude toward physical fitness at the end of BMT than at the beginning. Recruits (male and female) who were unable to pass the baseline run test were significantly more likely to report an improved attitude than those who did pass the baseline run. As **Exhibit 8** shows, the increase in the prevalence of positive attitudes occurred regardless of the type of PC program. In fact, among male recruits who completed BMT, the new PC program produced no significant changes in attitudes towards physical fitness compared to the old PC program. Among graduating female recruits who were physically fit at entry (i.e., able to pass the baseline run test), the new PC program appeared to produce a higher percentage with improved attitudes towards fitness than fit females in the old PC program. However, the 9% difference between fit females in the new PC program and fit females in the old PC program was not statistically significant.

Exhibit 8. Percentage of recruits whose attitudes towards physical fitness became more positive during BMT[1]

	Old PC Program		New PC Program		Overall	
	%	n	%	n	%	n
Females						
Passed Baseline Run	54%	81	63%	121	59%	202
Failed Baseline Run	66%	127	68%	137	67%	261
Males						
Passed Baseline Run	61%	518	58%	637	59%	1,155
Failed Baseline Run	66%	381	65%	311	66%	692

[1] Percentage with an increase in their composite attitudinal scale between the baseline and final questionnaires (among those who completed BMT).

5. The Effects of the New PC Program on Exercise-Related Injuries. Visits to Lackland AFB health-care facilities were monitored to assess illness and injury rates among study recruits. Thirty-nine (39) percent of males and 64 percent of females visited one of the participating health care facilities during the study period. Sixteen (16) percent of males and 37 percent of females had a clinic visit that involved a likely exercise-related diagnosis. To assess exercise-related injuries, recruits who had an encounter with a diagnosis (ICD 9 code) from the likely exercise-

related category were assumed to have an exercise-related injury. **Exhibit 9** shows that while the mean number of days with at least one medical encounter (any or exercise-related) varied significantly between males and females, there were no statistically significant differences between the new and old PC programs.

Exhibit 9. Mean Number of Days with One or More Clinic Encounters

Males				
	New PC		Old PC	
	Mean	(S.E.)[1]	Mean	(S.E.)[1]
Number of days with one or more:				
Clinic encounter:	0.914	(0.062)	0.792	(0.084)
Exercise-related clinic encounter:	0.329	(0.031)	0.292	(0.039)

Females				
	New PC		Old PC	
	Mean	(S.E.)[1]	Mean	(S.E.)[1]
Number of days with one or more:				
Clinic encounter:	1.857	(0.140)	1.875	(0.160)
Exercise-related clinic encounter:	0.942	(0.063)	0.832	(0.103)

[1] Standard errors include intracluster correlations attributable to differences between flights.

The follow-up questionnaire included several items to ascertain the frequency of unreported injuries and evaluate gender differences. Females were less than twice as likely as males to answer positively to experiencing some type of pain or injury during basic training but were two to three times more likely than males to report them to medical personnel. Fewer than 20 percent of recruits of both sexes reported any pain or injury experienced to appropriate personnel. The most frequent reason given for not reporting was "not serious enough", followed by "fear of recycling". The most common type of pain or injury experienced for both sexes was "pain in feet"—53.5 percent of females and 36.8 percent of males, followed by pain in shins or calves (51.9 percent of females and 34.4 percent of males). Blisters were reported by 44 percent of females and 34 percent of males. The most frequently reported "other injury" involved the ankle. For both sexes, recruits who passed the baseline were somewhat less likely to report pain or injuries to medical personnel or their TI than those who failed the baseline two-mile run standard.

Proportional hazards regression models (Kalbfleisch & Prentice 1980) were used to compare the time to the first exercise-related injury between the old and new PC programs. Separate models were developed for males and females. Each model included two covariates: 1) a variable indicating pass/fail status for the baseline two-mile run standard (used as a surrogate for level of fitness); and, 2) a variable indicating motivation to exercise[2]. All recruits with usable baseline two-mile run times were included in the models, including those who eventually recycled or dropped out of BMT. Recruits who did not have any exercise-related medical encounters were assigned a censored value that corresponded to the total number of training days. The model results, shown in **Exhibit 10**, indicate that the type of PC program was not a significant risk factor for either males or females. However, among females who did not pass the baseline two-mile run standard, the risk of the first exercise-related injury on any given training day was about 1.60 times higher than for those who passed the baseline run test. Similar risk factors were found among males who did not pass the baseline run test (1.57) and among males who were not motivated to exercise (1.54).

Exhibit 10. Proportional Hazards Regression Models for Number of Days Until First Exercise-Related Injury[1]

Independent Effect[2]	Females		Males	
	Risk Ratio[3]	Level of Sig.	Risk Ratio[3]	Level of Sig.
Failed Baseline Run:	1.60	0.004	1.57	0.002
Not Motivated to Exercise:	-	NS	1.54	0.03
New PC Program:	-	NS	-	NS

NS: Not significant at the 0.05 level.
[1] Separate models were developed for males and females.
[2] Interactive effects were not significant.
[3] The risk ratio is the relative odds of having a first exercise-related injury on a given day. The probability of such an event was about the same for members of both PC programs. However, male and female recruits who failed the baseline run had a significantly higher risk ratio than those who passed. In addition, males who were not motivated to exercise had a significantly higher risk ratio than males who were motivated to exercise.

*6. **The Effects of the New PC Program on BMT Attrition Rates.*** Based on 1994 USAF statistics, the overall attrition rate was 5 percent for males and 12 percent for females. Our study

[2] The motivation indicator was set to one if the baseline composite attitudinal variable was greater than or equal to 3.5, and zero otherwise. A level of 3.5 on a 5-point scale indicated that the respondent responded positively (on average) to 14 questions about attitudes towards exercise on the baseline questionnaire.

demonstrated attrition rates of 6.5 and 12.5 percent, respectively, for males and females. A total of 266 recruits were discharged from eligible flights during the study period, ten of whom were discharged for new medical conditions (i.e., the problem did not exist prior to service). Of these ten, seven (three males and four females) were in the old PC group. The remaining three (all females) were in the new PC group. Nine of the ten suffered stress fractures involving the foot or ankle, while the remaining recruit was discharged because of Achilles tendinitis. Another 134 recruits were discharged for pre-existing medical reasons.

We used a segmentation analysis to determine the combination of factors most related to attrition. For both male and female recruits, beginning BMT with a positive attitude toward exercise was the most significant determinant for completing BMT. In fact, as **Exhibits 11 and 12** show, motivated recruits who failed the baseline run were still able to complete BMT with lower-than average attrition rates. For a small minority of recruits, the combination of lack of motivation, failing the baseline run, and a fitness-related injury during the first week of training had a devastating effect on attrition rates. The type of PC program was not a significant determinant for either male or female recruits.

Next, we evaluated the effect of the new PC program on attrition rates by developing separate logistic regression models for male and female recruits. All recruits with usable baseline two-mile run times and questionnaire data were included in the analysis. The outcome variable was set to one for recruits who did not complete BMT (for any reason), and to zero for those who did complete BMT. We used motivation to exercise, ability to pass the baseline run, and the occurrence of a fitness-related injury during the first week of training as covariates in the models. The model results, shown in **Exhibit 13**, also indicated that the type of PC program was not a significant factor for either males or females. A fitness-related injury during the first week of BMT was the most significant risk factor with injured females being 4.72 times as likely to drop out as non-injured females, and injured males being 6.23 times as likely to drop out as non-injured males.

The relationship between lack of motivation and attrition was highly significant for both male and female recruits. Even after adjusting for their injuries during the first week and their ability to pass the baseline run test, unmotivated males were 4.28 times as likely to drop out of BMT as motivated males, and unmotivated females were 3.24 times as likely to drop out as motivated females.

We found a significant relationship between failing the baseline run test and not completing BMT among female recruits but not among males. Females who were unable to pass the baseline run test were 2.13 time as likely to drop out of BMT as females who passed. This noticeable distinction between male and female recruits stresses the importance of pre-BMT fitness activities to help reduce attrition rates among females.

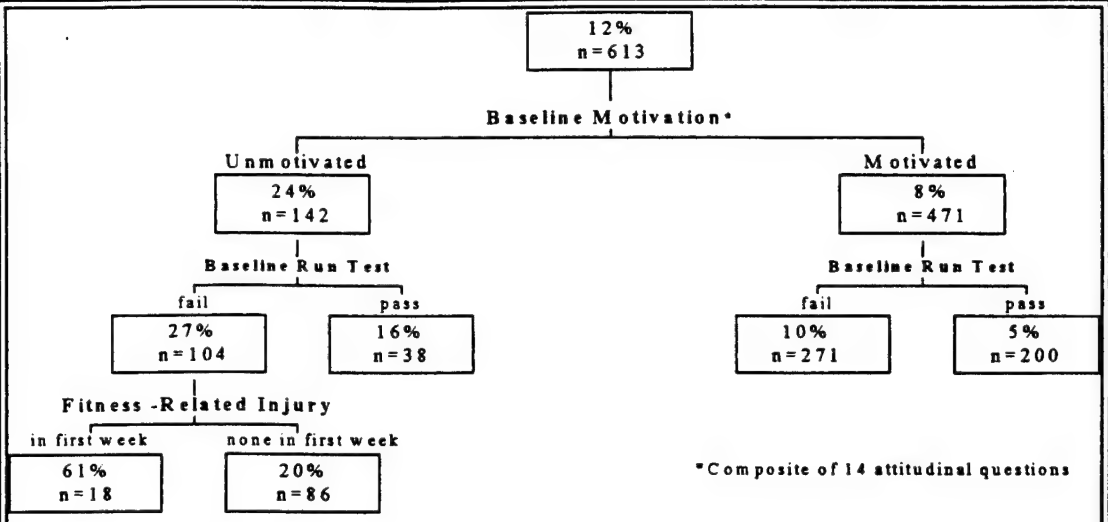

Exhibit 11. BMT Attrition Rates for Females. Overall, 12% of female recruits did not complete BMT. Among those who were not motivated to exercise however, the attrition rate doubled to 24%. The ability to pass the baseline run reduced the likelihood of attrition especially among females who were motivated to exercise.

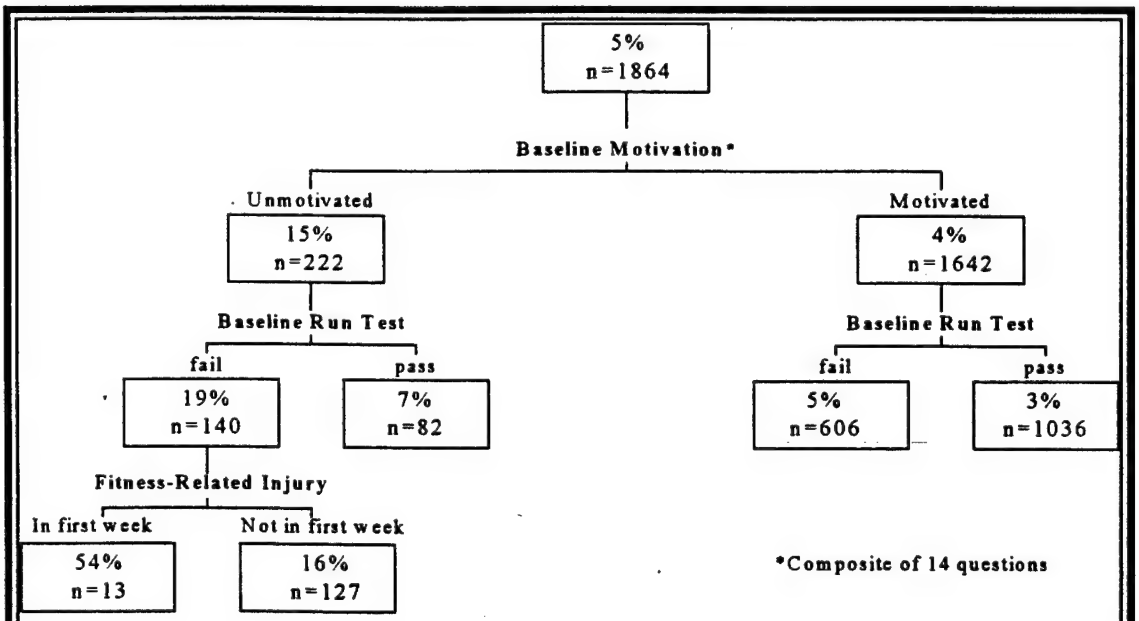

Exhibit 12. BMT Attrition Rates for Males. Overall, 5% of male recruits did not complete BMT. However, among those who were not motivated to exercise at baseline, the attrition rate tripled to 15%. The ability to pass the baseline run reduced the likelihood of attrition especially among males who were motivated to exercise.

Exhibit 13. Logistic Regression Models for Predictors of BMT Attrition[1]

Independent Predictor[2]	Females		Males	
	Odds Ratio[3]	Level of Sig.	Odds Ratio[3]	Level of Sig.
Failed Baseline Run:	2.13	0.05	-	NS
Injured during first week:	4.72	<0.001	6.23	<0.001
Not Motivated to Exercise:	3.24	0.002	4.28	<0.001
New PC Program:	-	NS	-	NS

NS: Not significant at the 0.05 level.

[1] Separate models were developed for males and females.

[2] Interactive predictors were not significant.

[3] The odds ratio reflects how much more likely it is for a recruit with a given predictor to drop out of BMT than those without after adjusting for other covariates in the model. For example, female recruits who failed the baseline run test were 2.13 times as likely to drop out of BMT as females who passes. Among males however, the ability to pass the baseline run test was not a significant factor.

CONCLUSIONS

Pre-Enlistment Fitness Activities. Our study found that during the 30 days prior to BMT, female recruits exercise about as long and as often as their male counterparts but not as intensely. Females tend to spend more time walking and less time playing sports than males. We found evidence that cross-training can enhance a pre-BMT running program. For female recruits, a combination of regular running and some bicycling significantly improved the likelihood of passing the baseline two-mile run test. The combination of a moderate running and walking program however, was found to have an adverse effect on the baseline run times of females compared to other combinations of exercises. We speculate that women who participate in an exercise program that combines slow running with walking may learn to run at a pace that is too slow to meet Air Force standards.

Male and female recruits who were able to pass the baseline run test had a significantly reduced risk of a fitness-related injury during the first week of BMT. We found that the occurrence of an injury early in training significantly reduced the likelihood of graduation for both males and females. Not surprisingly, we also found that recruits' attitudes toward physical fitness varied significantly by their ability to pass the baseline run test.

Only 39% of female recruits were able to pass the baseline run test compared to 60% of males. The poor physical performance among females is no doubt correlated to their reporting significantly lower levels of motivation to exercise than males. However, we also found that females who were able to pass the baseline run reported about the same level of motivation to exercise as males who did not pass the baseline run. This finding supports the theory that men and women react differently to the physical demands of BMT (Sallis et al. 1992).

Male and female recruits who arrived at BMT with a positive attitude toward exercise were significantly more likely to complete BMT than their unmotivated counterparts. In fact, other than avoiding an injury early in training, a positive attitude toward exercise was the single most important predictor of successfully completing BMT. Among female recruits, those who were motivated to exercise and able to pass the baseline run test had a 5% attrition rate, about the same as males. Even female recruits who failed the baseline run had a better-than-average chance of graduating if they began BMT with a positive attitude toward exercise.

The New PC Program. Our study found that the new PC program significantly improved the physical performance (as measured by two-mile run times) of both male and female recruits. While both the old and new PC programs produced sizeable reductions in mean run times over the course of BMT, the new PC program was significantly more effective among recruits who were able to pass the baseline run test. Among "already fit" male recruits, those in the new program were able to improve their mean run time by a minute more than their fit counterparts in the old program. The mean improvement among fit females in the new program was a full minute and 45 seconds better than the mean for fit females in the old program, a remarkable difference for a five-week

time period.

Although the new PC program was highly effective in improving the mean run times of fit females, it produced only marginal improvements over the old program among "unfit" females (i.e., those who were unable to pass the baseline run test). In fact, 91% of the unfit females in the old program were eventually able to pass the final run test (compared to 100% of the unfit females in the new PC program). Considering that the majority (61%) of female recruits were unable to pass the baseline run test, the marginal effect of the new PC program on the mean run times of unfit female recruits contrasts sharply with the highly significant effect of the new program on the run times of fit female recruits.

We found that the new PC program does not significantly increase the risk of fitness-related injuries during BMT even though much more time is spent exercising and running in the new program than in the old. As mentioned above, the primary determinant of a fitness-related injury among female recruits was not the type of PC program but whether they could pass the baseline run test.

During BMT, the number of recruits reporting an increased motivation to exercise increased dramatically regardless of the type of PC program. At least part of the increase in motivation may have been caused by the attrition of unmotivated recruits. In any case, we were unable to detect a significant difference between the two PC programs in the overall attitudes toward exercise (as measured by the composite attitudinal score) of graduating recruits. We did find however, that graduating females in the new program who were unfit at baseline became more amenable to strenuous exercise while those who were already fit showed a more positive attitude toward exercising to feel healthy.

Finally, we found that the new PC program did not significantly affect attrition rates during the study. Instead, the primary factors affecting the completion of BMT were determined before training even began. The study results indicated that both male and female recruits who had a positive attitude toward exercise and implemented a regular physical fitness program prior to the start of BMT were able to pass the baseline run test, avoid injuries early in BMT, and graduate at significantly higher rates than those who were unmotivated and unprepared.

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APPENDIX A. Data Available for Analysis

Item and Source	Description
Demographics USAF Personnel Systems Management	IDs, education, race, ethnic group, DOB, place of birth, sex, marital status, state of residence, entering height and weight, and AF ability test score.
Demographics Baseline questionnaire Post-training questionnaire	Self-reported race/ethnicity and education
Physical activity levels in the 30 days prior to leaving for BMT Baseline questionnaire	Type of exercise participated in; number of days of participation; usual duration per episode of participation for aerobic classes, calisthenics, jumping rope, cycling, running, jogging, stair climbing, walking, weight training, swimming, water skiing, basketball, baseball, football, soccer, hockey, tennis, other racket sports, handball, volleyball, boxing, wrestling, backpacking, rock climbing, horseback riding, roller blading, martial arts, and canoeing, and other self-propelled boating.
Exercise knowledge Baseline questionnaire Post-training questionnaire	Target heart rates, desired frequency and duration of exercise, principles of exercise, type of exercise programs to promote: endurance, aerobic fitness, and prevent injury, and benefits of exercise.
Self-confidence: Ability to work under stressors Baseline questionnaire Post-training questionnaire	Self-rated ability to preform physically demanding tasks, painful tasks, work under time pressure, and meet high expectations set by others.
Self-efficacy: Ability to develop and maintain an exercise program and meet USAF standards Baseline questionnaire Post-training questionnaire	Self-rated ability to plan an exercise program, confidence related to meeting physical conditioning and physical performance standards, and motivation to exercise.
Attitudes toward exercise: motivation, preferences, and reasons for exercising Baseline questionnaire Post-training questionnaire	Preference for: sports versus solitary activities, strenuous versus less strenuous activities, calisthenics versus running or sports. Reasons for exercise.

Item and Source	Description
Social influences Baseline questionnaire Post-training questionnaire	Friends, parents, teachers, and medical personnel
Nutrition: Knowledge and behaviors Baseline questionnaire Post-training questionnaire	Self-efficacy, social influences, attitudes, and behaviors.
Height and weight Post-training questionnaire	
Self-rating for fitness Post-training questionnaire	Self-ratings comparing physical competencies compared to other members of the flight: strength, stamina, flexibility, and body-mass index
Self-rating of fitness gains Post-training questionnaire	Comparison of current fitness levels to those at entry for: strength, speed, stamina, flexibility, and weight.
Injuries and pain during BMT Post-training questionnaire	Self-reports of injuries, reporting behavior and reasons for not reporting: blisters, pain in feet or toes, pain in shins or calves, knee pain, and other injuries
Physical fitness evaluations Baseline measurements Post-training measurements	Run-times, push-ups, and pull-ups.
Health utilization data Data collect on an on-going basis during the course of the study	Encounter date, new/follow-up visit, flight number, squadron number, week of training, chief complaint, description of activity when injured, diagnosis, disposition, and duty status. ICD 9-CM code.
Daily status reports, separation reports, and discharge data Data collect on an on-going basis during the course of the study	Information on recruits who had to interrupt BMT including duty status and date; separation dates and reasons for medical discharges for those separating for medical reasons.

APPENDIX B: Classification of Physical Activities

The following coding scheme, for classifying physical activity by rate of energy expenditure, is provided for the analysis of data gathered from the Physical Activity section of the U.S. Air Force Exercise Study, Trainee Questionnaire. This coding scheme employs five digits that classify activity by major headings (e.g. Bicycling, Conditioning exercise, Dancing, Running, Sports, etc.), the specific type of activity (e.g., tennis, singles, vigorous effort) and the intensity of activities. All activities are assigned an intensity unit based on their rate of energy expenditure expressed as the ratio of work metabolic rate to resting metabolic rate (METs). Energy expenditure in kilocalories or kilocalories per kilogram body weight can be estimated for all activities, specific activities, or activity types. See example below. This information was extracted from the article, Compendium of Physical Activities: Classification of energy cost of human physical activities, *Ainsworth, B.E., Haskell, W. L. Leone, A.S., Jacobs, D. R. Jr., Montye, H. J., Sallis, J. F., and Paffenberger, R. S. Jr.* MEDICINE AND SCIENCE IN SPORTS AND EXERCISE. 1993 Jan: 25 (1): 71-80).

Calculation of Energy Cost: By multiplying the body weight in kg by the MET value and duration of activity, it is possible to estimate a kcal energy expenditure that is specific to a person's body weight. Example from the article, page 73, Calculation of Energy Cost: Bicycling at a 4 MET value expends 4 kcalŸkg -1 body weightŸh-1. A 60-kg individual bicycling for 40 min expends the following: (4 METs X 60 kg body weight) X (40 min/60 min) = 160 kcal. Dividing 160 kcal by 40 min equals 4 kcal□min-1.

Activity Coding:

00	000	00.0
major heading	specific activity	intensity

Guidelines for coding specific activities were found at Appendix 3. General guidelines:

"All activities should be coded as "***general***" if no other information about the activity is given. This applies primarily to intensity ratings. If any additional information is given, activities should be coded accordingly."

Physical Activity questions extracted from the U.S. Air Force Recruit Fitness Study Trainee Questionnaire

Question 27. During the 30 days before you left to come to Lackland, did you go to any ***aerobic exercise classes***? **Code: 03015 METs: 6.0**

03	015		6.0
Dancing	Aerobic, ***general***	METs	

Notes/rational: Because intensity was not indicated , of the four specific activities available, the general code was chosen using the guidelines in Appendix 3.

Question 28. During the 30 days before you left to come to Lackland, did you ever do any ***calisthenics (push-ups, pull-ups, sit-ups, etc.)***? **Code: 02030 METs: 4.5**

02	030		4.5
Conditioning exercise	Calisthenics, home exercise, light or moderate effort, ***general***, going up & down from floor	METs	

Notes/rational: Because intensity was not indicated, of the two specific activities available, the general code was chosen using the guidelines in Appendix 3 of the Compendium.

Question 29. During the 30 days before you left to come to Lackland, did you ever ***jump rope***? **Code: 15551 METs: 10.0**

15	551	10.0
Sports	Rope jumping, moderate, ***general***	METs

Notes/rational: Because intensity was not indicated, of the three specific activities available, the general code was chosen using the guidelines in Appendix 3 of the Compendium.

Question 30. During the 30 days before you left to come to Lackland, did you ever ***ride a bicycle at a leisurely pace***? **Code: 01010 METs: 4.0**

01	010		4.0
Bicycling	Bicycling, <10 mph, ***general***, ***leisure***, to work or for pleasure	METs	

Notes/rational: Of the seven specific activities available the intensity level; leisurely, matched and is also the ***general*** code.

Question 31. During the 30 days before you left to come to Lackland, did you ever ***ride a bicycle at a rapid pace or uphill***? **Code: 01040 METs: 10.0**

01 Bicycling	040 Bicycling, 14-15.9 mph racing or leisure, fast, vigorous effort	10.0 METs

Notes/rational: Of the seven specific activities available the intensity level; racing or leisure, fast vigorous effort, most closely matched the question. Other bicycling codes related to racing very fast, slow or moderate effort.

Question 32. During the 30 days before you left to come to Lackland, did you ever ***run sprints***? **Code: 12180 METs: 10.0**

12 Running	180 Running, on a track, team practice	10.0 METs

Notes/rational: Of the sixteen specific activities available, running on a track, team practice, most closely matched the question. Other codes were rated by speed, e.g., 10.9 mph (5.5 minŸmile-1), METs 18.0, which is the highest in the running specific activity.

Question 33. During the 30 days before you left to come to Lackland, did you ever ***jog***? **Code: 12020 METs: 7.0**

12 Running	020 Jogging, ***general***	7.0 METs

Notes/rational: Match. Only one specific activity was provided for jogging.

Question 34. During the 30 days before you left to come to Lackland, did you ever ***run stairs***? **Code: 12170 METs: 15.0**

12 Bicycling	170 Running, stairs, up	15.0 METs

Notes/rational: Match.

Question 35. During the 30 days before you left to come to Lackland, did you ever ***walk at a brisk pace***? **Code: 17200 METs: 4.0**

17 Walking	200 Walking, 3.5 mph level, ***brisk***, firm surface	4.0 METs

Notes/rational: Match.

Question 36. During the 30 days before you left to come to Lackland, did you ever ***train with weights***? **Code: 02130 METs: 3.0**

02 Conditioning exercise	130 Weight lifting (free, nautilus or universal type), light or moderate effort, light workout, ***general***	3.0 METs

Notes/rational: Match. Only one specific activity was provided for using weights.

Question 37. During the 30 days before you left to come to Lackland, did you ever ***swim sprints***? **Code: 18280 METs: 11.0**

18 Water activities	280 Swimming, crawl fast (75 yards·min^{-1}), vigorous effort	11.0 METs

Notes/rational: Of the thirteen specific activities available; swimming, crawl, fast (75 yards·min^{-1}), vigorous effort, most closely matched the question.

Question 38. During the 30 days before you left to come to Lackland, did you ever ***swim laps***? **Code: 18240 METs: 8.0**

18 Water activities	240 Swimming laps, freestyle slow, moderate or light efforts	8.0 MET

Notes/rational: Because intensity was not indicated, of the two specific activities available, this code was chosen as the best match. The other specific activity was; swimming laps, freestyle , fast, vigorous effort with a MET of 10.0. No general code was provided for swimming laps.

Question 39. During the 30 days before you left to come to Lackland, did you ever ***swim leisurely (non-lap swimming)***? **Code: 18310 METs: 6.0**

18310	310	6.0
Water activities	Swimming, leisurely, not lap swimming, ***general***	METs

Notes/rational: Match.

Question 40. During the 30 days before you left to come to Lackland, did you ever ***water ski***? **Code: 18150 METs: 6.0**

18	150	6.0
Water activities	Skiing, water	METs

Notes/rational: Match.

Question 41. During the 30 days before you left to come to Lackland, did you ever ***play in a basketball game***? **Code: 15050 METs: 6.0**

15	050	6.0
Sports	Basketball, nongame, ***general***	METs

Notes/rational: Because intensity was not indicated, of the two specific activities available, the general code was chosen using the guidelines in Appendix 3. The other code was Basketball, game MET: 8.0.

Question 42. During the 30 days before you left to come to Lackland, did you ever ***shoot baskets***? **Code: 15070 METs: 4.5**

15	070	4.5
Sports	Basketball, shooting baskets	METs

Notes/rational: Match.

Question 43. During the 30 days before you left to come to Lackland, did you ever ***play in a baseball game***? **Code: 15620 METs: 5.0**

15	620	5.0
Sports	Softball or baseball,	METs

fast or slow pitch, ***general***

Notes/rational: Match.

Question 44. During the 30 days before you left to come to Lackland, did you ever ***play catch with a baseball***? **Code: 15235 METs: 2.5**

15	235	2.5
Sports	Football or baseball, playing catch	METs

Notes/rational: Match.

Question 45. During the 30 days before you left to come to Lackland, did you ever ***play in a football game***? **Code: 15230 METs: 8.0**

15	230	8.0
Sports	Football, touch, flag, ***general***	METs

Notes/rational: Because intensity was not indicated, of the two specific activities available, the general code was chosen using the guidelines in Appendix 3. The other code was Football, competitive METs: 9.0.

Question 46. During the 30 days before you left to come to Lackland, did you ever ***play catch with a football***? **Code: 15235 METs: 2.5**

15	235	2.5
Sports	Football or baseball, playing catch	METs

Notes/rational: Match

Question 47. During the 30 days before you left to come to Lackland, did you ever ***play soccer***? **Code: 15610 METs: 7.0**

15	610	7.0
Sports	Soccer, casual, ***general***	METs

Notes/rational: Because intensity was not indicated, of the two specific activities available, the general code was chosen using the guidelines in Appendix 3. The other code was Soccer, competitive METs: 10.0.

Question 48. During the 30 days before you left to come to Lackland, did you ever ***play ice or street hockey***? **Code: 15360 METs: 8.0**

15	360	8.0
Sports	Hockey, ice	METs

Notes/rational: Ice hockey is a match. There is not a code for street hockey. The assumption is made that street hockey would require the same energy expenditure.

Question 49. During the 30 days before you left to come to Lackland, did you ever ***play singles tennis***? **Code: 15690 METs: 8.0**

15	690	8.0
Sports	Tennis, singles	METs

Notes/rational: Match

Question 50. During the 30 days before you left to come to Lackland, did you ever ***play tennis, doubles***? **Code: 15680 METs: 6.0**

15	680	6.0
Sports	Tennis, doubles	METs

Notes/rational: Match

Question 51. During the 30 days before you left to come to Lackland, did you ever ***play any other racket sports like squash or racquetball***? **Code: 15530 METs: 7.0**

15	530	7.0
Sports	Racquetball, casual, ***general***	METs

Notes/rational: Because intensity was not indicated, of the three specific activities available, the general code was chosen using the guidelines in Appendix 3. The other codes were racquetball, competitive METs: 10.0 and Squash, METs: 12.0.

Question 52. During the 30 days before you left to come to Lackland, did you ever ***play handball***? **Code: 15320 METs: 12.0**

15	320	12.0
Sports	Handball, ***general***	METs

Notes/rational: Because intensity was not indicated, of the two specific activities available, the general code was chosen using the guidelines in Appendix 3. The other code was Handball, team METs: 8.0.

Question 53. During the 30 days before you left to come to Lackland, did you ever ***play volleyball***? **Code: 15720 METs: 3.0**

15	720	3.0
Sports	Volleyball, noncompetitive; 6-9 member team, ***general***.	METs

Notes/rational: Because intensity was not indicated, of the three specific activities available, the general code was chosen using the guidelines in Appendix 3. The other codes were; Volleyball, competitive, in gymnasium, METs: 4.0 and Volleyball, beach, METs 8.0.

Question 54. During the 30 days before you left to come to Lackland, did you ever ***box***?
Code: 15100 METs: 12.0

15	100	12.0
Sports	Boxing in ring, ***general***	METs

Notes/rational: Because intensity was not indicated, of the three specific activities available, the general code was chosen using the guidelines in Appendix 3. The other codes were Box, punching bag, METs 6.0 and Boxing, sparring, METs 9.0

Question 55. During the 30 days before you left to come to Lackland, did you ever ***wrestle***?
Code: 15730 METs: 6.0

15	730	6.0
Sports	Wrestling (one match = 5 min)	METs

Notes/rational: Match.

Question 56. During the 30 days before you left to come to Lackland, did you ever ***backpack***?
Code: 17010 METs: 7.0

17	010	7.0
Walking	Backpacking, ***general***	METs

Notes/rational: Match.

Question 57. During the 30 days before you left to come to Lackland, did you ever ***go mountain or rock climbing***? **Code: 17120 METs: 8.0**

17	120	8.0
Walking	Rock or mountain climbing	METs

Notes/rational: Match

Question 58. During the 30 days before you left to come to Lackland, did you ever ***go horseback riding***? **Code: 15370 METs: 4.0**

15	370	4.0
Sports	Horseback riding, ***general***	METs

Notes/rational: Because intensity was not indicated, of the four specific activities available, the general code was chosen using the guidelines in Appendix 3. The other codes were Horseback riding, saddling horse, METs: 3.4, Horseback riding, trotting, METs: 6.5 and Horseback riding, walking, METs: 2.5.

Question 59. During the 30 days before you left to come to Lackland, did you ever ***go rollerblading***? **Code: 15590 METs: 7.0**

15	590	7.0
Sports	Skating, roller	METs

Notes/rational: No other activity matched. The assumption is made that both take the same amount of energy to perform.

Question 60. During the 30 days before you left to come to Lackland, did you ever ***participate in martial arts***? **Code: 15430 METs: 10.0**

15	430	10.0
Sports	Judo, jujitsu, karate, kick boxing, tae kwan do	METs

Notes/rational: Match

Question 61. During the 30 days before you left to come to Lackland, did you ***paddle a canoe, rowboat, kayak, or other kind of boat***? **Code: 18070 METs: 3.5**

18	070	3.5
Water activities	Canoeing, rowing, for pleasure, ***general***	METs

Notes/rational: Because intensity was not indicated, of the eight specific activities available, the general code was chosen using the guidelines in Appendix 3. The other codes were; Canoeing, on camping trip, Mets: 4.0; Canoeing, portaging, METs: 7.0; Canoeing, rowing, 2.0-3.9 mph, moderate effort, METs: 3.0; Canoeing, rowing, 4.0-5.9 mph, moderate effort; Canoeing, rowing, >6mph, vigorous effort; Canoeing, rowing, in competition, or crew or sculling, METs: 12.0 and Kayaking, METs: 5.0

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APPENDIX C: Data Edits for Time Spent Exercising 30 Days Prior to BMT

As encountered in many sample surveys, we faced the problem of analyzing data sets that contain missing or invalid responses for some items. These response errors are an obvious source of bias that must be considered in the data analysis (Cox and Cohen, 1985, p.238). Since one of our objectives is to test whether hours of activity prior to entry is related to pre run time, we first had to impute data for number of hours spent exercising for each of the 35 pre-BMT fitness activities.

We used the following criteria to determine whether a value needed imputation. First, for each of the 35 pre-enrollment activities, there was a problem flag variable that indicated whether the respondent provided incomplete data about the number of hours in the previous thirty days that they spent participating in the activity. Second, we decided that values representing activity for greater than 240 hours (eight hours a day for thirty days) would be considered excessive and improbable. For both of these two situations, we reasoned that, because the respondents had provided some data, albeit incomplete or improbable, it was likely that they had in fact participated in the activity. We therefore choose to impute the number of hours they spent on the activity to the mean number of hours reported for this activity for a subset of respondents who had indicated participation in the activity. The subsets included respondents who were not flagged as having problems and who indicated that they had participated in the particular activity for greater than zero but less than 240 hours in the previous thirty days. Subsets were also separated by gender.

After imputing this data, we arranged the 35 activities into the six major groups (conditioning, sports, biking, running, walking and water sports) described in Appendix B. We summed the number of hours across the activity groups and discovered that for some respondents, the number of hours for the 35 individual activities weren't excessive, but the totals for the activity groups were. Often this was due to the respondent reporting border-line excessive hours for several activities. We decided that for these cases, where multiple activities were likely to have problems, further imputation would not be helpful. Therefore, if any of the sums of hours for the six activity groups were greater than 240, we excluded the respondent's data. Finally, we summed the hours for all activities and excluded respondents whose total hours were excessive. A total of 34 (out of 647) females and 302 (out of 2,166) males were excluded because of excessive activity group hours or total hours reported. The imputation process is summarized for each of the 35 individual activities in the following table.

Exhibit C-1. Imputed Values for Hours Spent Exercising 30 Days Prior to BMT

	Female Recruits					Male Recruits				
Fitness Activity	# = ZERO	# > ZERO	# IMPUTED	IMPUTED MEAN	OVERALL MEAN	# = ZERO	# > ZERO	# IMPUTED	IMPUTED MEAN	OVERALL MEAN
AEROBICS	488	119	6	16.23	2.85	1,766	88	10	21.88	0.91
CALISTHENICS	186	398	29	13.17	7.84	542	1255	67	15.86	9.31
JUMP ROPE	557	51	5	3.27	0.24	1,718	137	9	4.23	0.20
BIKE SLOW	341	259	13	11.83	4.58	1,187	643	34	19.06	4.97
BIKE FAST	437	168	8	6.39	1.64	1,348	497	19	13.32	2.71
RUN SPRINTS	479	124	10	6.39	1.30	1,305	530	29	7.68	1.64
JOGGING	169	416	28	10.53	6.00	607	1,209	48	10.82	5.81
RUN STAIRS	459	151	3	7.51	1.57	1,601	246	17	7.26	0.86
FAST WALK	175	405	33	20.10	12.92	1,240	553	71	22.71	6.17
WEIGHTS	409	192	12	14.60	3.91	1,022	802	40	22.03	8.28
SWIM SPRINTS	572	40	1	7.19	0.31	1,687	175	2	10.91	0.54
SWIM LAPS	516	95	2	6.92	0.92	1,607	242	15	9.44	0.80
SWIM SLOW	375	226	12	17.03	5.30	1,241	578	45	18.70	4.31
WATER SKI	551	59	3	4.96	0.23	1,595	258	11	13.87	1.40
BASKET GAME	478	131	4	11.52	1.90	966	869	29	28.62	10.35
SHOOT BASKETS	401	199	13	9.34	2.61	865	959	40	17.46	6.77
BASEBALL GAME	530	81	2	9.54	1.00	1,523	324	17	18.73	2.37
CATCH BASEBALL	489	119	5	4.51	0.74	1,421	418	25	7.11	1.35
FOOTBALL GAME	575	35	3	10.35	0.38	1,477	376	11	13.07	1.76
CATCH FOOTBALL	513	93	7	3.79	0.53	1,144	693	27	6.96	1.96
SOCCER	574	38	1	12.31	0.68	1,663	193	8	12.81	1.12
HOCKEY	602	10	1	14.10	0.17	1,774	86	4	22.03	0.69
SINGLES TENNIS	553	58	2	12.38	0.94	1,643	211	10	12.88	1.25
DOUBLES TENNIS	589	24	0	-	0.16	1,799	63	2	9.37	0.16
RACKET SPORTS	580	33	0	-	0.23	1,755	102	7	10.20	0.53
HANDBALL	605	8	0	-	0.02	1,837	25	2	7.36	0.09
VOLLEYBALL	450	157	6	10.97	2.62	1,364	483	17	12.29	2.66
BOXING	599	14	0	-	0.22	1,741	117	6	10.41	0.41
WRESTLING	578	33	2	14.35	0.72	1,679	181	4	12.32	1.01
BACKPACKING	572	39	2	12.96	0.81	1,680	174	10	19.56	1.48
MTN/ROCK CLIMBING	549	63	1	8.97	0.66	1,617	235	12	12.77	1.40
HORSEBACK	526	85	2	16.66	1.97	1,721	134	9	14.65	0.94
ROLLERBLADING	526	85	2	14.51	1.77	1,668	186	10	17.37	1.48
MARTIAL ARTS	595	17	1	13.39	0.30	1,732	125	7	27.56	1.37
CANOE/BOATING	556	55	2	7.55	0.61	1,630	221	13	10.77	0.99

APPENDIX D: Correlation Analysis of Attitudinal Variables

Questionnaire Item	Female Recruits		Male Recruits	
	Correlation with Total	Cronbach's Alpha	Correlation with Total	Cronbach's Alpha
Q 5. Frequent participation in physical activities is all right for some people, but not for me.	0.45	0.82	0.36	0.85
Q 6. In order to feel healthy, I need to participate in vigorous exercise.	0.43	0.83	0.44	0.84
Q 9. I only exercise because I am required to exercise.	0.54	0.82	0.55	0.84
Q 10. I exercise because I want to improve my endurance.	0.57	0.82	0.51	0.84
Q 11. I exercise because I want to become stronger.	0.56	0.82	0.52	0.84
Q 16. By carefully planning an exercise routine, I can improve my physical fitness.	0.33	0.83	0.42	0.85
Q 17. I am able to do physically demanding tasks.	0.50	0.82	0.61	0.83
Q 18. I am able to do physically painful tasks.	0.44	0.82	0.57	0.84
Q 19. I am able to perform well under pressure.	0.44	0.83	0.49	0.84
Q 20. I am able to perform well when other people have high expectations of me.	0.46	0.82	0.49	0.84
Q 21. I am willing to work extra hard to improve my physical fitness so that I will be a valuable member of my flight.	0.50	0.82	0.61	0.83
Q 22. After BMT, I expect to be able to with anyone in the Air Force, as part of a dedicated and strong team.	0.38	0.83	0.45	0.84
Q 25. I am confident that I'll be able to meet the fitness and weight standards for the Air Force.	0.53	0.82	0.45	0.84
Q 26. I am confident that I'll be able to meet the performance standards for any career field that I will be assigned to.	0.41	0.83	0.47	0.84